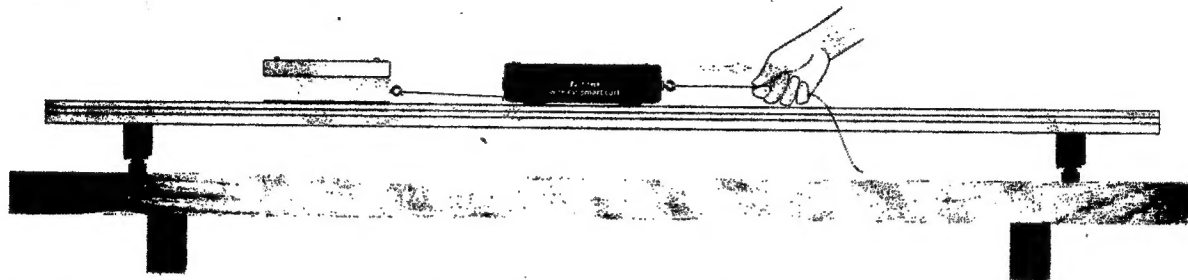# Investigation 5C: Static and kinetic friction

Essential question: What determines the force of friction?

Friction is everywhere and can be either helpful or wasteful depending on the situation. In this investigation you will test models of friction against actual measurements to get a sense of how accurate these friction models are.

Coefficient of static friction and kinetic friction

1. Open the experiment file **05C_Friction**, and then connect the Smart Cart to the software using Bluetooth.
2. Set up the equipment like the picture. Zero the Smart Cart force sensor while nothing is touching the hook.
3. Start data collection, and then very slowly pull on the string, increasing the force you exert until the block starts to slide. Once the block is sliding, keep pulling at a constant speed until you get to the edge of the table, and then stop data collection.
4. Record the mass of the block in the table.
5. Repeat this activity two more times, each time adding a 250-g mass on top of the block.
6. For each trial, use the graph tools to find the maximum force exerted just as sliding was about to start (static friction force), and the average force while the block was sliding (kinetic friction force). Record the values for each trial in the table.

Table: Coefficient of static friction and kinetic friction

Trial	Max Force	Average Force While Sliding	Mass of Block	Static Friction Coefficient μ_s	Kinetic Friction Coefficient μ_k
3	≈5.46N	3.71 N	.620 kg		
2	4.28	2.61 N	.370 kg		
1	1.97N	1.36 N	.120 kg		

Average value for μ_s: _____   Average value for μ_k: _____

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Instructions

a. Draw two free-body diagrams of the friction block: one representing the moment just before it began to slide (static friction), and one representing the time when it was sliding at a constant speed (kinetic friction). Label all the forces acting on the block in each diagram, including

b. The coefficients of static and kinetic friction are defined as the ratios of each frictional force to the normal force of the block. Write two equations: one for the coefficient of static friction, and one for the coefficient of kinetic friction--both in terms of the frictional force and the mass of the block.

c. Determine the coefficients of static friction and kinetic friction for each of the trials you performed. Enter these values in the table. Calculate the average for each.

d. The model for static friction treats μ_s as constant, even as the mass of the friction block was increased. Do your data support this model? Explain your answer.

e. Compare your average values to the tabulated values for the coefficients of static and kinetic friction in section 5.4 of your text. Using your data, evaluate the precision of the tabulated coefficients.

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